In the new number of the Journal of the Bombay Natural History Society, Lieutenant H. E. Barnes continues his interesting papers on nesting in Western India. Speaking of house-sparrows, he says that no amount of persecution seems to deter them from building in a place when they have once made up their minds to it. At Deesa, he found that a pair had built a large nest in the antlers of a sambur in the veranda. Another pair made a nest in the soap-box in the bath-room, and although the nest was destroyed several times, they would not desist, and at last, "from sheer pity," he had to leave them alone. The most peculiar case was when a pair had a nest in a bird-cage hanging against the wall, just above where the "durzi" sat all day working, and close to a door through which people were passing in and out continually. The door of the cage had been left open, the previous occupant having been transferred elsewhere. Not only were four eggs laid, but the nestlings were reared, although the cage was frequently taken down to be shown to visitors. Once the eggs were nearly lost, a boy having taken them out. The fuss made by the birds led to the recovery of the eggs. The author has a curious note on another peculiarity of sparrows. "I have often," he says, "had to turn the face of a looking-glass to the wall to prevent them from injuring themselves, for immediately one of them catches a glimpse of himself in it, he commences a furious onslaught on what he imagines must be a rival, and, if not prevented, will continue fighting the whole day, only leaving off when darkness sets in, recommencing the battle at dawn the next day. I once tried to see how long it would be before the bird gave in, but after two days, seeing no likelihood of his retiring from the unequal contest, I took pity on him and had the glass covered up. The bird did not seem in any way exhausted, although I do not think that he had a morsel of food for two days."

Some remarkable electrical phenomena accompanying the production upon the large scale of solid carbon dioxide are described by Dr. Haussknecht, of Berlin, in the current number of the *Berichte* of the German Chemical Society. In order to obtain large quantities of solid carbonic acid it is found most convenient in practice to allow the liquid stored in the usual form of iron cylinder to escape into a stout canvas bag, best constructed of sail-cloth or some such strong fabric, instead of the usual lecture-room receiving apparatus, the cylinder being inclined from the vertical so as to permit of a ready and uniform exit from the opened valve. The liquid under these circumstances issues at pressures varying from 60–80 atmospheres, and a compact snow-like mass of solid carbon dioxide is formed in the canvas receiver, owing, as is well known, to the extreme lowering of the temperature of the liquid due to its sudden expansion and the accompanying absorption of heat. When the experiment is performed in the dark, the canvas receiver is seen to be illuminated within by a pale greenish-violet light, and Dr. Haussknecht states that electric sparks 10–20 cm. long dart out from the pores of the cloth. If the hand is held in these sparks the usual pricking sensation is felt, similar to that perceived on touching the conductor of an electric machine at work. Dr. Haussknecht further states that the phenomenon is very noticeable in the dark whenever there is a leakage in any portion of the compressing apparatus or the manometers connected therewith. The reason assigned for this development of statical electricity is similar in principle to that usually accepted in explanation of the hydro-electric machine of Sir William Armstrong. As the liquid carbonic acid is issuing from the valve it becomes partly converted into gas which is violently forced through every pore of the canvas. Moreover, carried along with this stream of gas are great quantities of minute globules of liquid, which are brought in forcible contact with the solid particles already deposited. Dr. Haussknecht therefore considers that the electrical excitation is due mainly to the violent friction between these liquid globules and the solid snow. It is very essential for the successful reproduction of these electrical phenomena that the carbon dioxide should be absolutely free from admixed air; that prepared artificially yielding much finer results than that obtained from natural waters, which latter contains considerable quantities of air. The luminosity is not generally developed in the interior of the receiver until a crust of solid carbonic acid 0·5–1 cm. thick has been deposited, which renders the probability of the correctness of the above theory all the greater. Dr. Haussknecht has constructed a special form of apparatus, with which he is now experimenting, with the view of being able to determine the sign, nature, and quantity of the generated electricity.

The additions to the Zoological Society's Gardens during the past week include two Brown Capuchins (*Cebus fatuellus* ♂ ♂), an Ocelot (*Felis pardalis*), a Coypu (*Myopotamus coypus*), two Ring-tailed Coatis (*Nasua rufa*), two Cayenne Lapwings (*Vanellus cayennensis*), seven Burrowing Owls (*Speotyto cunicularia*) from South America, presented by Mr. James Meldrum; a Pig-tailed Monkey (*Macacus nemestrinus* ♀) from Java, presented by Mr. C. Powell; a Common Hare (*Lepus europæus*), British, presented by Mr. H. T. Bowes; three Pintails (*Dafila acuta* ♂ ♂ ♀), European, a Mandarin Duck (*Æx galericulata* ♀) from China, presented by Mr. G. F. Mathews, R.N., F Z.S.; a Common Boa (*Boa constrictor*) from South America, presented by the Directors of the Museum, Demerara; two Cheer Pheasants (*Phasianus wallachii* ♂ ♀) from Northern India, twelve Common Teal (*Querquedula crecca*, 4 ♂, 8 ♀), European, purchased; a Viscacha (*Lagostomus trichodactylus*), a Red Kangaroo (*Macropus rufus*), born in the Gardens.

THE IRON AND STEEL INSTITUTE.

On Wednesday and Thursday of last week the annual spring meeting of the Iron and Steel Institute was held. The gathering was announced to extend over Friday also, but for some reason, best known to those who had the control of the meeting, the second day's proceedings were so hurried through that all the business was disposed of by half-past one o'clock on the second day; no less than six papers being taken at the one sitting. Naturally there was very little discussion; and indeed the second day of the meeting might almost as well have been dispensed with, and copies of the papers given to members to take home to read at their leisure. It is seldom that we have been present at a duller gathering than that which the meeting became towards its close, there not being a dozen members present to hear the Secretary hurry through the papers one after another, the President apparently being only anxious that there should be no discussion to prolong the proceedings.

The following is a list of the papers read:—On the manufacture of war material in the United States, by Mr. W. H. Jaques, of Bethlehem, U.S.A.; on tests for steel used in the manufacture of artillery, by Dr. Wm. Anderson, Director-General of Ordnance; on certain pyrometric measurements and the method of recording them, by Prof. Roberts-Austen, F.R.S.; on the changes in iron produced by thermal treatment, by Dr. E. J. Ball, London; on a graphic method of calculating the composition of furnace charges, by Mr. H. C. Jenkins; on economical puddling and puddling cinder, by Prof. Thomas Turner, Birmingham; on the micro-structure of steel, by M. Osmond, of Paris. There were three other papers which were not read.

Upon the members assembling in the theatre of the Institution of Civil Engineers, which was lent for the occasion by the Council of the latter Society, according to their hospitable custom, Sir James Kitson, the retiring President, occupied the chair. After the usual formal business had been transacted, the new President, Sir Frederick Abel, F.R.S., was duly installed, and at once proceeded to deliver his inaugural address. Sir Frederick is also this year President of the British Association, and should spend a busy autumn attending both the meeting of the Iron and Steel Institute in Birmingham, and of the Association in Cardiff. The address was of considerable length, embracing a wide range of subjects and a long span of time. The duration of Sir Frederick Abel's official life has been long, exceptionally long for the years he has lived, for he obtained employment in the Government service at an early age. It was shortly after the outbreak of the Russian War that he succeeded the illustrious Faraday in the Professorship of Chemistry at the Royal Military Academy, and since then he may be said to have seen almost the whole history of the birth and subsequent growth of applied science in connection with the industries of iron and steel making. At the beginning of his career, he tells us in his address, those who, in this country, appraised at their proper value the services which the analytical and scientific chemist could render to the iron-master and manufacturer of steel might be counted on the fingers. Systematic mineral analysis was just in process of application, volumetric analysis was altogether in its infancy, and spectroscopic analysis was not even dreamt of. The metallurgic operations in the Arsenal at Woolwich were limited to the production of small castings of brass for fittings of gun carriages, and to the casting of bronze ordnance for field service. Our supplies of cast-iron ordnance for siege and naval use were drawn from a very few of our most renowned iron-works, and our shot and shell were exclusively supplied from private works. What Woolwich has become since those days—and in spite of its faults of administration it is something of which the country may be proud—and how large a part Sir Frederick has borne in this development, most of our readers must be well aware. In those days our most powerful guns were 8-inch smooth bore 68-pounders of cast-iron, weighing 95 hundredweight, and fired with a charge of 18 pounds of powder. Now we have the 110-ton breech-loading rifled gun, built up of steel hoops and tubes, the calibre of which is 16¼ inches, and which throws a steel projectile weighing 1800 pounds with a powder charge of 960 pounds. Notwithstanding the fact that the 110-ton gun is in advance of its time—our mechanical skill and engineering knowledge not yet being sufficient to properly carry out the design—it would be difficult perhaps to find a more striking example of the application of scientific principles to the industrial arts; although we must not forget that the credit of the advance is due rather to Elswick than to Woolwich.

Leaving the region of historical retrospection, the address makes reference to the proposal of Prof. Langley, of Michigan University, made at the last Bath meeting of the British Association, that a series of samples of steel should be distributed between the metallurgical experts of different countries, in order that they might be analyzed and a part deposited as standards in each of the countries. The sets of samples supplied to each country were to be identical in composition, but each set would contain specimens varying in composition. The results of the analyses were to be compared, the object being to promote greater uniformity of procedure and a selection of the best methods. The Crescent Steel Works of Pittsburg have supplied the samples, and the English experts have almost completed their work. Should the Commission succeed in bringing about uniformity of practice in this respect, it will do much towards lightening the work of those who have to compare the results arrived at in different countries. Sir Frederick next referred to Dr. Sorby's method of examination of iron and steel by microscopic examination of carefully prepared samples, in which the structure has been developed by treatment with a weak acid. It will be remembered that Dr. Sorby gave a description of his process in a paper read before the Iron and Steel Institute two or three years ago; and since then Dr. Herman Wedding has followed the matter up with success. Many years previously Faraday had pursued an analogous course of investigation. It is satisfactory to learn that "the systematic application of Sorby's system of microscopic examination of prepared surfaces of steel and iron is continually extending at the German works, and that many series of experiments have demonstrated that by this system of examination characteristic features of grades of iron may be discovered, physical differences co-existing with identity of chemical composition explained, and evidences of the true grounds of disasters obtained." A very interesting subject next occupied a place in the address. This was the self-destruction, if one may use the term, of steel projectiles by the development of cracks. It is well known that steel projectiles may be received from the manufacturer to all appearance perfectly sound, and after a time cracks will develop themselves. In extreme cases the occurrence has been so sudden that a violent rupture, attended by a sharp report, has taken place. The cause doubtless is the surface treatment to which the shot is subjected in order to get the requisite hardness, and which leads to internal strains being set up. In one case mentioned in the address the head of the projectile had been thrown to a distance of many feet by the violent spontaneous rupture of the metal. The importance of rest in bringing about a diminution, if not entire disappearance, of internal strains in masses of metal is illustrated by the behaviour of chrome steel projectiles, which had to be stored for several months before their transport to a distance could be ventured upon. In connection with this subject Sir Frederick referred to a previous report in which he dwelt upon the effect of time in establishing chemical equilibrium in masses of metal. He also quoted a letter written to him by Thomas Graham, when Master of the Mint, in which was discussed the tendency to the development of cracks in tempered steel dies, and stating that in the Mint it was generally considered that if such dies were kept in store for a year or two, they became less apt to crack when in use, and coined more pieces than dies newly tempered. The same phenomena have to be considered in the manufacture of steel ordnance; and an instance was given by the lecturer of the tube of a large gun which had fired three proof rounds. A circumferential crack was found to have become developed in the front threads of the breech screw, and, upon removing the jacket from the tube the crack extended forward along the chamber and into the rifling. When the tube was placed in the lathe, with a view to cutting off the injured portion, the crack suddenly developed itself with a loud report, and ran along to within eight feet of the muzzle; a spiral crack at the same time ran completely round the tube, which fell in two upon removal from the lathe. This instance will strengthen the hands of those who are opposed to oil-hardening the parts of a steel gun; and Sir Frederick's own words in connection with this vexed question are worth quoting. "One effect which the oil-hardening treatment has occasionally exercised in the case of particular qualities of steel is that of developing minute fissures or cracks in the metal, either superficially or in the interior of the mass. This cannot, of course, be rectified by any annealing process, and it is still a question, to be determined by the teachings of experience and the result of investigations, whether any definite or reliable modifications in the composition of steel used for guns, tending to secure the desired combination of hardness and tenacity may not be introduced, with the result that a method of treatment of the metal may be discarded which, however carefully applied, and however efficient the means adopted for reducing or neutralizing its possible prejudicial influence upon the physical stability of the parts of which a gun is built up, carries with it inherent elements of uncertainty and possible danger." Dr. Anderson's remarks on the subject of oil-hardening should also be read in connection with the observations contained in the President's report. On the whole, perhaps, it would not be rash to predict that the days of this process are numbered in connection with the manufacture of steel ordnance for Her Majesty's service. For a long time many of our best authorities have been opposed to it.

We have not space to follow the address into the subject of the effect of silicon in cast-iron. General interest in this matter was aroused a year or two ago by a paper read before the Iron and Steel Institute by Thomas Turner, of Mason's College; and since then the investigation has been followed up by German experimentalists, with a general result that, under certain conditions, it is concluded that silicon will contribute to the production of dense and homogeneous castings.

The following passage from the address speaks for itself. It would be well if it could be printed and distributed to every British iron or steel maker:—

"The absolute dependence of the development of new metallurgic processes upon the results of the labours of the analyst, the chemical investigator, the physicist, and the microscopist, and the thoroughness with which this all-important fact is appreciated by the German metallurgic establishments, afford new occasion for a regretful recognition of the distance which we are still behind our Continental brethren in availing ourselves of the advantages afforded by the constant pursuit of scientific research, and the thoroughly efficient, systematic, and direct application of the labours of the scientific investigator to the daily operations at works of all kinds, although it must be acknowledged that of late years we have made important progress in these directions. It has certainly been humiliating to have to admit that industries which the genius of individual

Englishmen, possessed of exceptional powers of applying to important practical purposes the results of research, have created and have developed to an extent foreshadowing their high importance, gradually passed out of our hands through the far-sightedness of the Germans, who have very long since recognized the absolute dependence of progress in such industries upon the constant pursuit of chemical research into the far-reaching and continually spreading ramifications of organic chemistry. Thus, in fields of work, where, in days past, and even of late, our industrial chemists have been content to pursue their attempts at progress with the co-operation of one or two young chemical assistants, small armies of highly-trained chemists, who have gained academic honours, and have won their spurs in original investigation, are in constant employment at the magnificent manufacturing establishments in Germany, systematically pursuing researches which constitute successive indispensable links in a great network of exhaustive inquiry, and which, while conferring large benefits on the science itself, are continuously productive of improvements in existing processes, or of the development of new methods, while, ever and anon, they result in some fresh discovery of great technical importance and high commercial value. Similarly elaborate and comprehensive arrangements now exist at important German iron and steel works for systematic investigation and comparison of materials of products and processes.”

We must hurry over the remaining parts of Sir Frederick's address, and can only mention some of the chief subjects touched upon, referring our readers to the Proceedings of the Institute for fuller information. Thus we find the following matters occupying attention: the presence and effect of nitrogen in iron; the state in which carbon exists in steel; Osmond's study, by means of the Le Chatelier pyrometer, of the slow cooling of iron and steel, together with the phenomena of recalescence, and the existence of two allotropic forms of iron; the effect of aluminium in iron; Hadfield's researches in connection with manganese steel; the progress of nickel steel; and the interesting discovery of Langer, Quincke, and Ludwig Mond of the action of carbonic acid upon finely divided nickel at high temperature, in which it was found that the metal had the power of separating carbon from the gas, with production of carbonic acid in place of the oxide. These and other matters were dealt with at greater or less length, and constituted a most interesting and characteristic address.

Only one paper was read on the first day of the meeting. This was Dr. Anderson's contribution on tests for steel used in the manufacture of artillery. The announcement of a contribution on this subject by the Director-General of Ordnance Factories had caused a good deal of interest both among the scientific and manufacturing members of the Institute, more especially as it was known that the Government authorities had been overhauling the official test regulations. Unfortunately, however, the meeting was a little too early, so far as Dr. Anderson's paper was concerned, for the new regulations have not yet been officially published, and, until they are, it is against official etiquette, if not official rules, that they should be made known. The paper was therefore very like the play of “Hamlet” with the Prince of Denmark left out, and bore evidence of having been brought forward rather with a view of fulfilling a promise than because the author had anything new to advance. It was not Dr. Anderson's fault that his paper was robbed of its chief interest, and certainly the thanks of the Council were due to him for good-naturedly allowing it to stand on the programme. Notwithstanding what we have said, the paper was very interesting, but as we hope to hear Dr. Anderson again on the subject, when the official veto has been removed by publication of the new tests, we shall treat the matter briefly. It is first pointed out that the mechanical properties of steel, and of alloys generally, are affected in a remarkable manner by extremely minute quantities of substances, by the relative proportions, by the changes in some or all, produced by the more or less rapid changes of temperature, which influence dissociation and reveal their effects by recalescence; indicating, to a less degree, allotropic changes in some or all of the components. Chemical analysis sufficiently minute to detect even traces of every substance associated with iron would be tedious and costly. Years must pass away before chemical and physical science together will succeed in determining the laws which govern the mechanical properties of alloys. For these reasons, and others, the specifications of gun-steel used in Her Majesty's service exclude all definitions of chemical composition, so far, at any rate, as ordinary ingredients are concerned. The author thinks it is not sufficiently realized that metals are incapable of appreciable cubical compression under any stress that can in practice be brought to bear on them, whether fluid, pasty, or cold. Like ice and water, steel and cast-iron have a greater volume in a solid than in the liquid state, and, therefore, red-hot solid cast-iron or steel floats on the surface of the molten mass: although, it should be added, cold cast-iron will at first sink in a bath of liquid iron, but will rise to the surface and float when it has acquired a sufficient degree of heat to bring it about to a cherry red. This was shown by the well-known experiments of Mr. Wrightson, referred to at the meeting. The manner in which, during cooling, compressive stress is suddenly turned into tension high enough to cause rupture (due to the swelling during solidification) is dealt with; this being a subject also treated upon in the President's address. The bearing of these phenomena upon the process of hardening is also discussed. The relative influence of carbon in iron as a definite compound of carbon and iron dissolved in an excess of iron, and as a finely subdivided carbon diffused through the mass, is considered, and the author expresses an opinion that the “apparently capricious behaviour of steel” is due not only to the internal stresses engendered by oil-hardening, but also to the circumstance that the chemical condition of the steel and its molecular structure are greatly influenced by comparatively slight errors of judgment, or by carelessness in the adjustment of the temperatures at which the operations are performed.

A discussion followed the reading of the paper, in which the most interesting incident was Mr. Wrightson's description of his experiments to determine the volume of cast-iron at different temperatures. Mr. Edmunds, of Woolwich, defended the practice of oil-hardening for gun-steel; and Mr. Hadfield would attribute cracks in steel rather to contraction than expansion.

On the second day of the meeting the proceedings were opened by Prof. Roberts-Austen giving a verbal description of the Le Chatelier pyrometer, an instrument which is now well known to the scientific world. It may be of interest to state that Sir Lowthian Bell and other practical men spoke of the great assistance this pyrometer had been to them in the course of manufacturing operations.

M. Osmond's paper on the micro-structure of steel was no more than a note which accompanied the presentation of a series of micro-photographs. The paper of Dr. E. J. Ball, which followed, was supplemental to a previous paper contributed by him (see Journal Iron and Steel Inst., 1890, No. 1, p. 85); and, as the present paper will be supplemented by another, we will refer our readers to the Proceedings, merely giving the general conclusions arrived at by the author, which are as follows:—“(1) That in iron containing 0·1 per cent. of carbon, the tenacity of the metal increases by hardening, either in oil or in water, with the temperature at which the metal is quenched with a view to hardening, a maximum tensile strength being reached at a temperature of about 1300° C. This temperature once exceeded, however, the tenacity of the metal diminishes, although the extensibility increases. (2) By raising the percentage of carbon from 0·1 to 0·2, the maximum tenacity is attained, not at 1300° C., but at a much lower temperature—about 1000°—below the melting-point of iron oxide, which, moreover, was not present. (3) By further considerably increasing the percentage of carbon, this point of maximum tenacity apparently disappears almost entirely, the annealed metal having nearly as high a tensile strength as the same metal which has been quenched in oil from any temperature up to a bright red heat. Beyond this temperature, or when quenched in water, the hardened metal became so hard and brittle that it could not be gripped by the jaws of the testing machine.” It will be remembered by those who attended the meeting when Dr. Ball's last paper was read that M. Osmond put forward the idea that the fourth point in change (in addition to Osmond's three points), which occurs, according to Dr. Ball, in very mild steel at a temperature approaching the melting-point, might be due to the fusion of iron oxide. The present paper is founded on this remark, but for the results, beyond the salient features given, we must, as we have said, refer our readers to the originals. Mr. Turner's paper, which was read next, does not require a detailed notice at our hands. It was an economic paper on a subject which is rapidly losing economic interest; and the author does not appear to have made himself well acquainted with the labours of previous investigators in this field. The paper of Mr. Jenkins does not admit of an abstract being made; whilst the last paper read, that of Lieutenant Jaques, U.S.N., was of such a voluminous nature that it might better be described as a treatise, and is far beyond our scope, as may be judged from its title.

The autumn meeting of the Institute will probably be held at Birmingham.

THE ROYAL SOCIETY SOIRÉE.

THE *soirées* given by the Royal Society become every year more pleasant. The one held on Wednesday, May 6, was in every sense most successful. We note some of the objects exhibited:—

Mr. J. Wimshurst exhibited an electrical influence machine (alternating and experimental).

The Trotter curve ranger was shown by Mr. A. P. Trotter. This portable instrument is intended to facilitate setting out large curves for railway and other work. It dispenses with tables of angles and with the use of chains and assistants. No cumulative error can arise as with theodolite work.

Profs. Rücker and Thorpe, FF.R.S., exhibited a map showing the probable connection of lines towards which the magnet is attracted in England and France. Profs. Rücker and Thorpe found that the north pole of a magnet is attracted to a line which runs south from Reading, and enters the Channel near Chichester. M. Moureaux has traced a similar line from Fécamp to the south of Paris, but its southern termination has not yet been discovered. The directions of the two lines make it probable that they are parts of the same axis of disturbance.

The Director-General of the Geological Survey exhibited:—(1) Specimens illustrating the phosphatic chalks in England, France, and Belgium, arranged by Mr. A. Strahan, Geological Survey of England and Wales. Phosphatic band in the upper chalk of Taplow, containing about 30 per cent. of phosphate of lime. Taplow phosphatic chalk separated by washing into: (1) brown sand composed of phosphatised organisms, and containing about 50 per cent. of phosphate of lime; (2) chalky mud composed largely of rhabdoliths, coccoliths, and discoliths. Microscopic preparations of the phosphatised organisms of the Taplow chalk, showing Foraminifera, prisms of Inoceramus shell, fish-scales, fish-bones, and fish-pellets. Photographs of the Taplow phosphatised organisms, by Mr. J. J. H. Teall, F.R.S. Phosphatic chalk of Beauval (Somme), and microscopic preparation. Phosphatic chalk of Ciply (Belgium), and microscopic preparation.—(2) Illustrations of a former Arctic climate in the Lowlands of Scotland, determined by Mr. Clement Reid, Geological Survey. At Hailes, about three miles south-west of Edinburgh, in a thin seam of silt, resting immediately on boulder clay, Mr. J. Bennil, of the Geological Survey of Scotland, has lately found numerous remains of plants. These show a climate probably 15° or 20° colder than that of the Lowlands at the present day. In the following list the peculiarly Arctic species are marked with an asterisk. The only *tree* is an alder. The willows are all dwarf species; two of them (*Salix herbacea* and *S. reticulata*) still live on the higher mountains of Scotland, the third (*S. polaris*) is an Arctic form now extinct in Britain. At the same locality there is another deposit, probably of later date, which contains only plants still living in the neighbourhood, including several trees.

Thalictrum
Ranunculus aquatilis
Viola
Stellaria media
Oxalis acetosella
Hippuris vulgaris
**Loiseleuria procumbens*
Menyanthes trifoliata
Stachys palustris
Ajuga reptans
Chrysanthemum Leucanthemum
Polygonum aviculare
**Salix herbacea*
**Salix polaris*
**Salix reticulata*
Alnus
Empetrum nigrum
Potamogeton
Eleocharis palustris
Scirpus pauciflorus
Scirpus lacustris
Scirpus?
Carex?
Isoetes lacustris

The Executive Committee of the Silchester Excavation Fund exhibited (by permission of the Duke of Wellington):—(1) Iron tools and utensils of the Roman period, found together in a pit in the Romano-British city at Silchester, Hants, in September 1890.—(2) Bronze objects of the Roman period found at Silchester.

Prof. H. Carrington Bolton, Ph.D. (of New York), exhibited musical sand, from Arabia, United States of America, and the Hawaiian Islands, collected by the exhibitor.

Prof. H. G. Seeley, F.R.S., exhibited remains of Anomodont Reptiles from the Trias, Karoo, Cape Colony.

The Director of the Royal Gardens, Kew, exhibited a collection of views in the Royal Gardens, Kew, showing the development of the Gardens during the last fifty years. This series is a portion of a very extensive and valuable collection of prints, drawings, and photographs of the most interesting features in the Royal Gardens. It has been brought together during the past twenty years, and is now deposited for exhibition in Museum No. 3.

Messrs. J. E. H. Gordon and Co. exhibited Tomlinson regulator for electric light mains. The Tomlinson regulator is intended for use in transformer sub-stations. It is worked by a wire from the central station, but automatically corrects any error of the attendant at the central station. Ordinary automatic apparatus cannot be safely used for this purpose, as, though should such get out of order when taking out transformers, no harm is done except the waste of coal, yet if it gets out of order when putting in transformers it may burn up the sub-station. The peculiarity of the new apparatus is that if anything whatever goes wrong, all transformers are at once put in, thus ensuring absolute safety. By the courtesy of the Brush Company, and of the Metropolitan Electric Supply Company, who have lent the necessary machinery, the apparatus has been tried on a large scale in the Brush Company's works. A plant of 1950 lights capacity has been run for 24 hours with, and for 24 hours without, the new apparatus, with the result of a saving of 4¼ cwt. of coal, or, in other words, with the new apparatus there was a saving of 89 pounds of coal per 8 c.p. lamp per annum, or about 26 per cent. of the total coal bill.

Sir J. B. Lawes, Bart., F.R.S., and Dr. J. H. Gilbert, F.R.S., showed:—(1) Three enlarged photographs of Leguminous plants, grown in 1889, in experiments on the question of the fixation of free nitrogen. The plants were grown, in some cases with sterilization, and in others with microbe-seeding of the soil. With suitable microbe-infection of the soil, there was abundant formation of the so-called *leguminous nodules* on the roots of the plants, and there was, coincidently, very considerable fixation of free nitrogen. The evidence at command points to the conclusion that the free nitrogen is fixed in the course of the development of the organisms within the nodules, and that the resulting nitrogenous compounds are absorbed and utilized by the higher plant.—(2) Coloured drawing, by Lady Lawes, of the Rothamsted rain-gauges.—(3) Coloured drawing, by Lady Lawes, of the Rothamsted drain-gauges.

Old plan of the Mint in the Tower of London, exhibited by the Hon. Sir C. W. Fremantle, K.C.B. This document is described as an exact survey of "The Ground Plot or Plan of His Majesty's Office of Mint in the Tower of London." It bears the date 170$^{0}_{1}$, and must have been prepared by the order of Sir Isaac Newton, who was appointed Master of the Mint in 1699. The position of Newton's official residence is shown at A.

Mr. R. E. Crompton, M.Inst.C.E., exhibited:—(1) Section of armature winding, showing copper divided, twisted, and compressed, to avoid loss from eddy currents.—(2) Crompton's method of obtaining accurately sub-multiples of the ohm; for current-measuring purposes.

Prof. Oliver Lodge, D.Sc., F.R.S., exhibited:—(1) Revolving mirror. Rapid revolving mirror driven by clock-work, with detachable fan to give moderate speeds, with adjustable main spring to vary the speed, and with vacuum cover for highest speeds (the last not yet satisfactory). Slow moving index, to enable the speed to be determined; and electro-magnetic brake to regulate its going, or to stop it gradually. Mirror, 2·3 × 1 cm., silvered back and front; very light, but giving fair definition. It makes 5760 revolutions for 1 of the winding arbor. Used for analyzing sparks, and observing the speed of electric pulses along conductors of various kinds. Made by Mr. W. Groves.—(2) Clock for pointing out continually the direction of the earth's orbital motion. (Two home-made forms.) A disk, or dial, set on a polar axis with the obliquity of the ecliptic, is driven by a clock against the rotation of the earth. On the dial are recorded 365 days of the year. It is set once for all in the plane of the ecliptic, with the actual date pointing 90° from the sun. In the first instrument I devised, the direction of the right-dated radius of the dial henceforth points out the direction of the earth's motion at any instant, if the clock keeps